

INSTRUMENTATION FOR THE CHARACTERIZATION OF INFLATABLE STRUCTURES

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ABSTRACT

Current entry, descent, and landing technologies are not practical for heavy payloads due to mass and volume constraints dictated by limitations imposed by launch vehicle fairings. Therefore, new technologies are now being explored to provide a mass- and volume-efficient solution for heavy payload capabilities, including Inflatable Aerodynamic Decelerators (IAD) [1]. Consideration of IADs for space applications has prompted the development of instrumentation systems for integration with flexible structures to characterize system response to flight-like environment testing. This development opportunity faces many challenges specific to inflatable structures in extreme environments, including but not limited to physical flexibility, packaging, temperature, structural integration and data acquisition [2].

In the spring of 2012, two large scale Hypersonic Inflatable Aerodynamic Decelerators (HIAD) will be tested in the National Full-Scale Aerodynamics Complex's 40' by 80' wind tunnel at NASA Ames Research Center. The test series will characterize the performance of a 3.0 m and 6.0 m HIAD at various angles of attack and levels of inflation during flight-like loading. To analyze the performance of these inflatable test articles as they undergo aerodynamic loading, many instrumentation systems have been researched and developed. These systems will utilize new experimental sensing systems developed by the HIAD ground test campaign instrumentation team, in addition to traditional wind tunnel sensing techniques in an effort to improve test article characterization and model validation. During the 2012 test series the instrumentation systems will target inflatable aeroshell static and dynamic deformation, structural strap loading, surface pressure distribution, localized skin deflection, and torus inflation pressure.

This paper will offer an overview of inflatable structure instrumentation, and provide detail into the design and implementation of the sensors systems that will be utilized during the 2012 HIAD ground test campaign.

- [1] Clark, I.G., Hutchings, A.L., Tanner, C.L., Braun, R.D., "Supersonic Inflatable Aerodynamic Decelerators for Use on Future Robotic Missions to Mars," *Journal of Spacecraft and Rockets*, Vol. 46, No. 2, March 2009.
- [2] Brandon, E.J. et al., *Structural Health Management Technologies for Inflatable / Deployable Structures: Integrated Sensing and Self-Healing*, *Acta Astronautica* (2010), doi:10.1016/j.actaastro.2010.08.016